



# CRTM Technical Sub-Group Report

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# CRTM 2.0 Released (1)

- Version 2.0 of the CRTM released March 12, 2010. Available at **<ftp://ftp.emc.ncep.noaa.gov/jcsda/CRTM/REL-2.0>**
- The 2.0 User Guide is also available there **[ftp://ftp.emc.ncep.noaa.gov/jcsda/CRTM/CRTM\\_User\\_Guide.pdf](ftp://ftp.emc.ncep.noaa.gov/jcsda/CRTM/CRTM_User_Guide.pdf)**
- Email address for CRTM Support:  
**[NCEP.List.EMC.JCSDA\\_CRTM.Support@noaa.gov](mailto:NCEP.List.EMC.JCSDA_CRTM.Support@noaa.gov)**
- Many people at the JCSDA (and EMC and STAR) have been involved in the update, but special mention must be made of
  - Yong Han (NESDIS/STAR)
  - Quanhua Liu (NESDIS/STAR/Dell Perot)
  - Yong Chen (NESDIS/NESDIS/CIRA)for their efforts in implementing and testing all the new science features.



# CRTM 2.0 Released (2)

Yong Han's talk details the CRTM 2.0 updates. Briefly:

- New Science
  - Multiple transmittance models, including SSU-specific model.
  - Zeeman-splitting transmittance for SSMIS upper-level channels
  - Visible sensor capability
  - Matrix operator method (MOM) in radiative transfer
  - Additional IR sea surface emissivities developed by Nick Nalli (see poster)
  - Surface BRDF for solar affected shortwave IR channels
  - IR reflectivity over water changed from Lambertian to specular
- Interface changes
  - Initialisation function
  - User accessible structure definitions use Fortran2003 features to mitigate memory leakage problems. To delineate this change from previous versions of the CRTM the various structure procedures have been renamed.
  - **Options** structure specific changes to accommodate input for new features (e.g. SSU, Zeeman, etc)



# CRTM 2.0.1 (!)

- To address various issues with the 2.0 release, we're targeting end of April for a minor update, REL-2.0.1
- No changes will be made that alter results. Only minor fixes made (e.g. makefiles, error messages, example code, address compiler bugs, etc).

The screenshot shows a web browser window with the address bar containing the URL <https://svnemc.ncep.noaa.gov/trac/crtm/report/3>. The browser's navigation bar includes buttons for Back, Forward, Reload, Stop, Home, and Print. Below the address bar, there are several navigation links: Subversion Server, CRTM list, EMC ftp, CRTM ftp, CRTM webtest, SAIC, EMC Forum, LBLR TM doc, and MonoRTM doc. The main content area displays a section titled "Milestone REL-2.0.1" with "(6 matches)". Below this title is a table with the following data:

Ticket	Summary	Component	Version	Type	Owner	Status	Created
#111	Update CRTM makefiles to check for Fortran2003 compliance.	src	2.0.1	defect		new	04/05/10
#112	Modification of `Type_Kinds.f90` to remove conditional LLong and Quad kind types.	src	2.0.1	refactor		new	04/05/10
#114	Workaround in CRTM_Atmosphere_AddLayerCopy procedure to allow for PGI compilation	src	2.0.1	refactor		new	04/06/10
#110	Test of SensorData % Tb	src	2.0.1	defect	paul.vandelst@noaa.gov	accepted	03/31/10
#113	change n_Azi from MAX_N_AZI to a needed value	src	2.0.1	enhancement	quanhua.liu@noaa.gov	reopened	04/06/10
#141	Incorrect error message in CRTM_Atmosphere_IsValid() function.	src	2.0.1	defect		new	04/09/10



# CRTM 2.1

- The next update to CRTM science is targeted for a July 2010 release.
  - Currently planned updates:
    - FASTEM-4 (Q. Liu at JCSDA)
    - SOI radiative transfer algorithm (T. Greenwald at CIMSS/SSEC/UWisc)
  - Possible updates:
    - Implementation of new IR land surface emissivity models.
      - GrELS
      - UW HSR
- These are currently being tested in the data assimilation system at NCEP/JCSDA.

## Milestone REL-2.1 (2 matches)

Ticket	Summary	Component	Version	Type	Owner	Status	Created
#103	Implementation of updated MW sea surface emissivity model.	src	EXP-MWwater_SfcOptics	enhancement	quanhua.liu@noaa.gov	accepted	02/26/10
#80	Refactor of EXP-SOI branch RTsolution code to decouple RT algorithms.	src	EXP-SOI	refactor	paul.vandelst@noaa.gov	accepted	01/20/10



# CRTM Version Control and SCM

- In Feb2009 EMC's "public" version control and SCM server came online. This has proved invaluable for managing the software changes from multiple sources/branches – development is now much faster.

**CRTM**  
Community Radiative Transfer Model

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## CRTM Trac Wiki

### Current Release

The current CRTM release is [REL-2.0](#). The v2.0 release code and coefficient tarballs can be obtained from the [CRTM ftp site](#).

### Current Work

What we're currently working on:

- [REL-2.1](#)
  - [Successive Order of Iteration update](#). Implementation of the SOI RT solver.
  - [Microwave Water Surface Optics update](#). Implementation of FASTEM4 in the CRTM.
  - [Ticket status](#)
- [Infrared Land Surface Optics update](#)  
A new framework for surface emissivity models, starting with the IR land models.
- [NLTE](#)  
Adding a non-LTE capability to the CRTM.
- [TauProd](#) transmittance production
  - Setting up to use MonoRTM to compute our microwave transmittance profiles.
  - Updating our [TauProd](#) support software.

[CRTM Trac Wiki](#)  
[Current Release](#)  
[Current Work](#)  
[Developers](#)  
[Information for Developers](#)  
[Info about Trac](#)



# LBL model updates

- We (JCSDA) plan to completely recompute transmittances for all sensors this summer using latest LBLRTM (infrared) and MonoRTM (microwave).
- We have been working on a new spectral response function (SRF) data format to accommodate data from microwave sensors (ATMS and SSMIS).
- We are refactoring our transmittance production software to make these database calculations more “turnkey” (currently needs a lot of babysitting).
- JCSDA has a very productive collaboration with AER, Inc. as the source of LBL software and updates.....



# Consistency across Mid-infrared Spectral Regions

Mean residuals from 36 ARM TWP cases using Tobin et al. best estimate sonde profiles.

Profile inputs from AIRS Phase I val. supplied by L. Strow and S. Hannon (UMBC).

## LBLRTM

### CO<sub>2</sub> line coupling

Application of Niro et al. (2005)

### H<sub>2</sub>O line positions and strengths

Coudert et al. (2008)

### CO<sub>2</sub> line positions and strengths

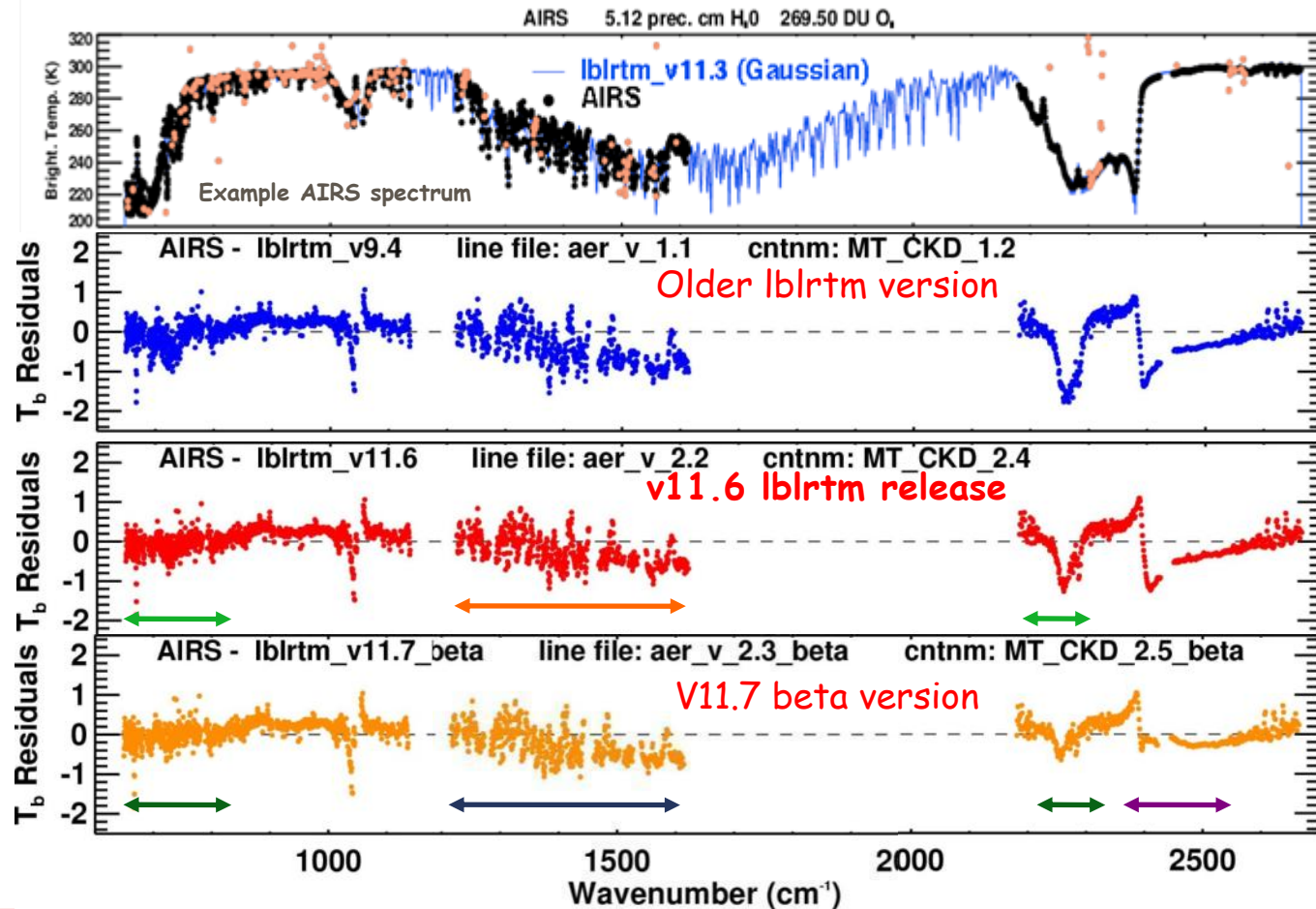
Tashkun et al., (1999)  
Already in use by MIPAS team (Flaud et al., 2003)

### H<sub>2</sub>O shifts, T-dep. Of widths

Gamache (personal comm.)

### CO<sub>2</sub>/H<sub>2</sub>O continuum

(see final LBLRTM v11.7 release)

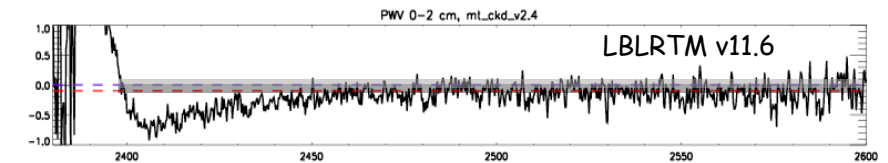
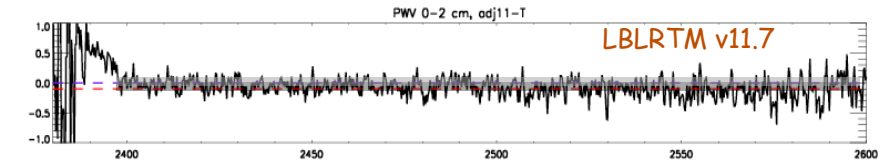




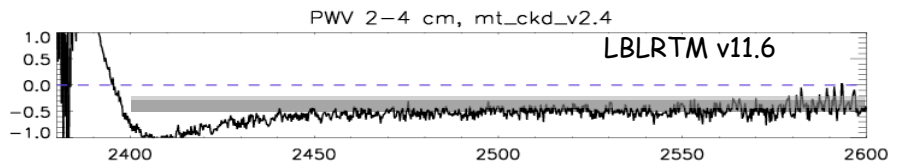
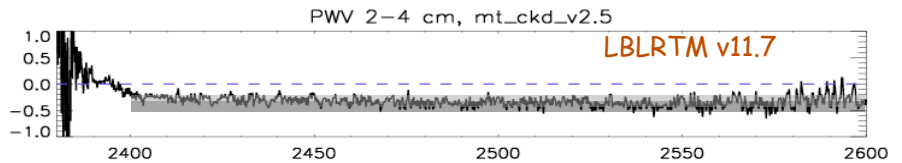
# V11.7 - IASI comparisons (CO<sub>2</sub> v3 band head)

- CO<sub>2</sub> continuum scaled to fit IASI observations in dry conditions (PW < 0.65 cm)
- Dependence of residuals on temperature/water vapor reduced by:
  - 1) Including temperature dependence of CO<sub>2</sub> continuum (based on line coupling coefficients at 200K, 250K and 340K in addition to 296K)
  - 2) Scaling of H<sub>2</sub>O self broadened continuum by a factor up to 5-7

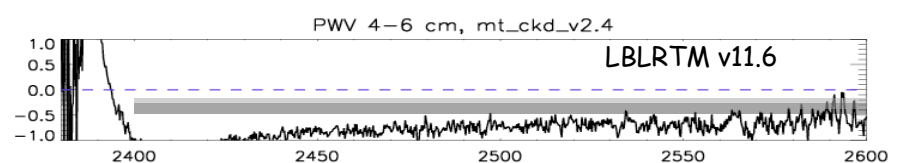
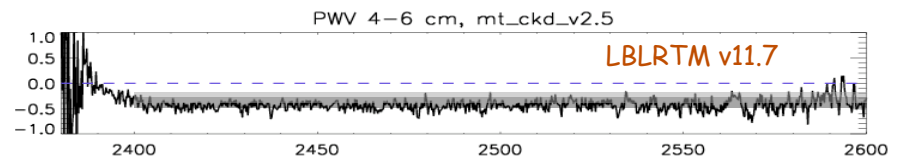
Dry



Moderate



Wet



# LBLRTM: future plans

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## ● NLTE:

- Added flexibility to accept user specified isotopes and NLTE bands (hard coded in current release) in special JCSDA release

## ● Future:

- Test with larger set of IASI/RAOB match ups and adjust atmospheric profiles using the radiometric measurements in selected spectral regions
- $\text{CO}_2$   $667 \text{ cm}^{-1}$  Q-branch (treatment of line coupling)
- $\text{CH}_4$  line coupling
- $\text{H}_2\text{O } \nu_2$ :
  - Line widths (R. Gamache, U. Mass Lowell)
  - Local continuum adjustment
  - HITRAN 2008 evaluation

# MonoRTM updates (summary)

- Water vapor continuum in microwave region recently updated (Payne et al. 2010) based on measurements from multiple ground based radiometers and well-located radiosonde measurements at ASR (ARM) SGP, NSA, COPS (FKB) sites
  - Agreement with new, independently readjusted, RSS continuum at 37 and 89 GHz is now quite good (RSS model not valid above 89 GHz)
- 5% difference in the 22GHz line width used in MonoRTM and in Rosenkranz and RSS models (affecting mainly interpretation of SSM/I and SSMIS measurements) remain unexplained.
  - MonoRTM line width validated at ARM sites (Payne et al., IEEE TGRS2008)

